

In the Claims

1. A high temperature solid oxide electrolyte fuel cell generator comprising:

5 a housing containing a top air feed plenum, a bottom fuel inlet, a reaction chamber containing fuel cells, and a reacted fuel-reacted air combustion chamber above the reaction chamber;

wherein inlet air can be heated internally within the housing in at least one interior heat transfer zone located between the reacted fuel-reacted air combustion chamber and the air feed plenum.

10 2. The fuel cell generator of Claim 1, wherein the air feed plenum is made from low temperature materials.

3. The fuel cell generator of Claim 1, wherein the fuel cell generator does not utilize exterior gas feed heat exchangers or pre-heaters.

15 4. A high temperature solid oxide fuel cell generator comprising:

1.) a source of air and a source of fuel;
2.) a top air feed plenum;
3.) a bottom fuel inlet plenum;
4.) a fuel electrochemical reaction chamber containing fuel cells;

20 5.) a recirculation chamber directly above the electrochemical reaction chamber in which a fraction of reacted and unreacted fuel are drawn into a recirculation loop;

6.) a combustion chamber directly above the recirculation chamber wherein fuel combustion products and reacted air from within the cells
25 combine to complete combustion of the unburned fuel;

7.) at least one interior heat exchanger zone in which the combustion products heat incoming air which is carried in ceramic air feed tubes; and

8.) a combustion products exhaust chamber which lies directly below the top air feed plenum.

30 5. The fuel cell generator of Claim 4, wherein the air feed plenum is made from low temperature materials.

6. The fuel cell generator of Claim 4, wherein the fuel cell generator does not utilize exterior gas feed heat exchangers or pre-heaters.

7. The fuel cell generator of Claim 4, wherein at least the fuel electrochemical reaction chamber is surrounded by at least one internal heater panel.

5 8. The fuel cell generator of Claim 4, wherein the interior of the ceramic air feed tubes within the interior heat exchanger zone contain at least one of metallic heat conducting inserts and electrically energized heater inserts.

9. A high temperature, solid oxide electrolyte fuel cell generator comprising:

10 1.) a housing defining an air plenum containing open tops ends of a plurality of air feed tubes;

2.) a source of air;

3.) a source of fuel;

15 4.) a pump for pumping air directly into the air entry plenum of the generator;

5.) a generator section within the bottom of the housing, containing a plurality of tubular fuel cells, each open at its top end, each having an exterior fuel electrode and an interior air electrode with solid oxide electrolyte therebetween, where the generator section connects to a source of fuel, and the plurality of air feed
20 tubes are inserted within the fuel cells so that the pumped air can contact the air electrodes; and

6.) a reacted fuel-reacted air combustion chamber at the top open end of the fuel cells;

25 wherein the air passing through air feed tubes can be heated internally within the housing in at least one interior heat transfer zone, which is disposed between reacted fuel-reacted air combustion chamber and the air plenum.

10. The fuel cell generator of Claim 9, wherein the air plenum is made from low temperature materials.

30 11. The fuel cell generator of Claim 9, wherein the fuel cell generator does not utilize exterior gas feed heat exchangers or pre-heaters.

12. The fuel cell generator of Claim 9, wherein at least the generator section is surrounded by at least one internal heater panel.

13. The fuel cell generator of Claim 9, wherein the interior of the air feed tubes within the interior of the interior heat transfer zone contain at least one of
5 metallic heat conducting inserts and electrically energized heater inserts.

14. The fuel cell generator of Claim 9, wherein a diverter valve is associated with the air pump to pass air into an internal heater and then into the combustion chamber and interior heat transfer zone.

15. A method of operating a high temperature solid oxide electrolyte fuel
10 cell generator which reacts feed fuel and feed oxidant at interior fuel cell surfaces comprising:

1.) feeding oxidant into at least one interior heat transfer zone within the fuel cell generator through an oxidant feed tube;

2.) contacting the oxidant feed tube within the at least one interior
15 heat transfer zone with exhaust spent fuel and spent oxidant products; and then

3.) exhausting cooled exhaust from the fuel cell generator, here, the oxidant is not heated before entry into the fuel cell generator.

16. The method of Claim 13, wherein before step 1, oxidant is pumped into an air feed plenum made from low temperature materials.

20 17. The method of Claim 13, wherein before step 1, exterior gas feed heat exchangers or pre-heaters are not utilized.